the water cooling of the engine parts, the various methods of ignition, and the principles of operation. Then follows a section on the arrangement of a gas-engine installation and the testing of the plant, whilst the two concluding chapters contain a good description of the various methods used for the governing of the engine and of the use of gas producers.

The book is stated on the title-page to be by the two authors mentioned in the heading to this review, and it is therefore puzzling on pp. 1, 110, and 152 to find "the author" only referred to. Possibly the book was written in sections, and this explanation appears plausible by reason of the curious contradictions that occur in it. Thus, on p. 1 it is stated that "the modern gas engine is a prime mover, perfectly reliable, cheaper in first cost, including the gas producer, than a steam engine and its boiler"; whereas on p. 21, we learn "the capital cost of the gas-engine plant is much greater than that of the steam-turbine plant," and on p. 152 that "the modern gas engine is very nearly as reliable a machine as a steam engine."

These statements should not all of them appear in one publication, as, even if explicable by some verbal modification, they tend to confuse the non-expert readers for whom this book is intended. It is this very use by the non-expert that renders slips in explaining the theory of the engine very unfortunate. On p. 5 an unlucky oversight has led to the statement appearing that if "pressure be kept constant the volume will vary as to absolute pressure." Again, the author or authors in stating (on p. 7) that "only a certain proportion of a given quantity of heat can be converted into work," neglect such a well-known fact that the heat conveyed to a gas to keep its expansion isothermal is all of it converted then and there into work.

These are matters which should be put right in a second edition, and, in view of the very thorough knowledge shown of the practical working of the engine and of the misfortunes to which it is sometimes liable, it is likely that there will be a large number of persons to whom the book will be of such value as to render a second edition a necessity. The description of the mode of working of the Clerk engine is specially good, and the letterpress is well illustrated. The authors commit themselves on p. 94 to an interesting prophecy concerning the probable future development of the gas engine.

"It seems likely," they say, "that in the future large gas-engine plants will be designed with engines working on two-stroke cycles, but, instead of each engine having its own charging pumps, a central set of independently driven pumps for gas and air will be provided"; "these pumps," they suggest, "will probably be of the turbine type, and of greater efficiency than is obtainable with pumps forming an integral part of the engine."

Finally, we welcome the book as an interesting addition to the less ambitious side of gas-engine literature, and foresee a useful place for it in the library of many persons who wish to learn something of this growingly important prime-mover.

RESINS, RUBBER, AND ESSENTIAL OILS.

Allen's Commercial Organic Analysis. A Treatise on the Properties, Modes of Assaying, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicine, &c. With Concise Methods for the Detection and Estimation of their Impurities, Adulterations, and Products of Decomposition. Edited by W. A. Davis and S. S. Sadtler. Vol. iv., Resins, India-Rubber, Rubber Substitutes, and Gutta-Percha, &c. Fourth edition, entirely rewritten. By the editor and the following contributors, M. B. Blackler, E. W. Lewis, T. M. Lowry, E. C. Parry, H. Leffmann, and C. H. Lowall. Pp. viii+466. (London: J. and A. Churchill, 1911.) Price 21s. net.

THE general characters of the new issue of Allen's work have been described in the notices of earlier volumes reviewed in this journal (NATURE, vol. lxxxv., pp. 37, 365). In this connection therefore it is only necessary to remark that the present volume is notable among its fellows for the rather large proportion of theoretical and descriptive chemistry which it contains.

Many users of the book, however, will probably find this a convenience. Considerable advances have been made in the chemistry of the resins and essential oils since the publication of the earlier editions, and many of the results have not hitherto been brought together. Taken with the numerous references supplied, the articles upon the three groups of products dealt with in the book—namely, resins, india-rubber, and essential oils—form an excellent summary of the general and analytical chemistry of these products. The following are a few out of many interesting matters to be found in the volume.

Thanks largely to the work of Tschirch and his coadjutors, it is now possible to make at least a provisional attempt at a satisfactory classification of the resins. The proximate constituents of these bodies, so far as they are yet known, may be divided into (1) *Resin-esters* and their decomposition products; (2) *Resinolic* or *Resin acids;* and (3) *Resenes;* the last being oxygenated compounds with no very characteristic chemical properties beyond the attribute—a very valuable one—of resistance to the action of alkalies. In many of the resins one or other of these three classes is the preponderating constituent, whence three groups can be distinguished, namely, *ester-resins, acid-resins,* and *resene-resins.* The first group, for instance, includes (among others), gum benzoin, storax, "dragon's blood," ammoniacum, and asafœtida; in the second group are the coniferous resins and copaiba balsam; and in the groups of resene-resins are included myrrh, olibanum, dammar, and Manila copal. From a number of the ester-resins the alcohol of the ester has been isolated, and Tschirch distinguishes two kinds of these alcohols—*resinols* and *resinotannols.* The former are colourless, and give no reaction for tannin when tested with iron salts; the latter are coloured and give a tannin-reaction. For the general analytical examination of resins, the acid, saponification, iodine, methoxyl, and acetyl

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values are the determinations most frequently useful in forming a conclusion.

The chemistry of the essential oils is no doubt better and more widely known than that of the resins. Nevertheless, in the interests of readers who are not specialists in this branch of chemical work, a summary of the chief facts respecting the composition of the essentials oils may not be unprofitable. These oils, to which the characteristic odours of flowers and plants are nearly always due, are composed of some half-dozen groups of compounds, one or two of the groups predominating in any particular oil. *Terpenes* constitute the bulk of many essential oils, but are seldom the most useful portion. In fact, various so-called "terpeneless" oils are now prepared, the removal of terpenes serving in effect to concentrate the odoriferous properties of the oil in the residual constituents. *Alcohols* of various types—open-chain, aromatic, and sesquiterpene alcohols—with their corresponding *aldehydes* and *ketones*, are the important compounds in many oils. Examples are the alcohol *geraniol* in otto of rose; the aldehyde *citral* in lemon-grass oil, and the ketone *pulegone* in oil of penny-royal. Bergamot, clove, and mustard oils respectively owe their special properties to *esters*, *phenols*, and *sulphur compounds*. Methods by which the proportions of the various constituents may be determined, usually with a fair approach to accuracy, are described at length in the volume, which can be recommended as well worthy of its place in the series.

C. SIMMONDS.

MECHANICS, THEORETICAL AND TECHNICAL.

(1) *Lehrbuch der technischen Physik.* By Prof. Hans Lorenz. Dritter Band, Technische Hydromechanik. Pp. xxi+500. (Munich and Berlin: R. Oldenbourg, 1910.) Price 14 marks.

(2) *Die Theorie der Kräftepläne.* By Prof. H. E. Timerding. Pp. iv+100. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 2.50 marks.

(3) *Vibrations of Systems having One Degree of Freedom.* By Prof. B. Hopkinson. (Cambridge Engineering Tracts, No. 1.) Pp. 54. (Cambridge: University Press, 1910.) Price 2s. 6*d*. net.

(4) *Leerboek der Werktuigkunde.* By F. J. Vaes. Vol. i., pp. xii+152. Vol. ii., pp. xiv+224. (Schiedam: H. A. M. Roelants, 1910.) Price 1.40 gulden.

THERE is probably no branch of science in which such wide gaps occur between theory and practice as in the study of the motion of fluids. We have, on one hand, the mathematical theory of hydrodynamics, which is limited by the difficulty of obtaining soluble problems and building up integrals of the differential equations of motion subject to given boundary conditions. This difficulty alone restricts the scope of the investigation mainly to the study of perfect fluids, thus immediately introducing a discrepancy between theory and observation. On the other hand, we have the hydraulics of the engineering student, the object of which is mainly to enable numerical calculations to be made regarding such problems as town water supply, efficiency of turbines, pumps, propellers, and ships.

In endeavouring to produce a text-book on technical hydromechanics (1) which should be satisfactory both from a theoretical and from a technical point of view, Prof. Lorenz thus undertook a duty of enormous difficulty. It is not surprising that when he had half finished the manuscript in 1906 he was so dissatisfied with the result that he decided to start afresh, a task which he did not commence until 1908, after re-studying the subject and making a number of original investigations. That such difficulties would exist was shown not only by what he describes as the "step-motherly" treatment of this subject in technical colleges, but also by the absence of any comprehensive treatise covering the required ground. Books on hydraulics generally treated the subject entirely from Bernouilli's principle, combined with the hypothesis of parallel sections, nothing being said about Euler's equations of motion in three dimensions, much less of their modifications for viscous fluids. In one case the treatment of hydraulics was preceded by an introduction on hydrodynamics, an order of treatment likely to confuse rather than enlighten the "applied science" student. On the other hand, we have purely theoretical treatises on hydrodynamics, where practical applications are represented only by half a chapter on the hypothesis of parallel sections, and this Cambridge lecturers, at any rate formerly, told their students to omit.

The order of treatment adopted by Prof. Lorenz is probably the best that could be devised for the object in view. Starting with analytical hydrostatics (including the oscillations of floating bodies, and surface tension) the author next deals with steady, and subsequently with variable, one dimensional motion treated by the hypothesis of parallel sections. These chapters constitute hydraulics proper, and contain applications to flow over weirs and through sluices, pumps, efficiency of turbines, and propellers, long waves in canals, and tides. The extension of the investigation to three dimensional motion leads up quite naturally to Euler's equations of motion of a perfect fluid, problems in irrotational motion, both continuous and discontinuous, vortex motion, and viscosity. In addition to such problems as are commonly treated in hydrodynamics, we have discussions of the oscillations of ships, including a digression on the Schlick gyroscope, approximate theories of the turbine, and of the resistance of ships, and the equations of motion of underground waters. The latter subject might with advantage be brought more prominently than it has been before mathematical students in this country. It affords excellent examples of motion derived from a potential, and the divergence between theory and observation is probably less than in Eulerian irrotational motion. Not the least important feature is a concluding chapter on the history of hydrodynamics. A few points in the book might be improved. The proof of the permanence of irrotational motion on p. 342 scarcely appears conclusive. The equation shows that if the components of spin are ever zero their rates of change will also be zero. This does not

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